03-30-06

DAC IFW

EV829402841US

PTO/SB/64 (10-05)
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PETITION FOR REVIVAL OF AN APPLICATION FOR PATENT ABANDONED UNINTENTIONALLY UNDER 37 CFR 1.137(b)	Docket Number (Optional) S230-USA

OIPE IAP78 MAR 2 8 2006 PATENT & TRADEMARK OFFICE

First named inventor: Robert J. Greenberg

Application No.: 10/638,989 Art Unit:

Filed: 08/11/2003 Examiner:

Title: INSULATED IMPLANTABLE ELECTRICAL CIRCUIT

Attention: Office of Petitions
Mail Stop Petition
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450
FAX (571) 273-8300

NOTE: If information or assistance is needed in completing this form, please contact Petitions Information at (571) 272-3282.

The above-identified application became abandoned for failure to file a timely and proper reply to a notice or action by the United States Patent and Trademark Office. The date of abandonment is the day after the expiration date of the period set for reply in the office notice or action plus an extensions of time actually obtained.

APPLICANT HEREBY PETITIONS FOR REVIVAL OF THIS APPLICATION

NOTE: A grantable petition requires the following items:
(1) Petition fee;
(2) Reply and/or issue fee;
(3) Terminal disclaimer with disclaimer fee - required for all utility and plant applications filed before June 8, 1995; and for all design applications; and
(4) Statement that the entire delay was unintentional.

1. Petition fee

☑ Small entity-fee $ 750.00 (37 CFR 1.17(m)). Applicant claims small entity status. See 37 CFR 1.27.

☐ Other than small entity – fee $ ____________ (37 CFR 1.17(m))

2. Reply and/or fee

A. The reply and/or fee to the above-noted Office action in the form of Letter and Annexes 1-4 (identify type of reply):

☐ has been filed previously on ____________.
☑ is enclosed herewith.

B. The issue fee and publication fee (if applicable) of $ ____________.
☐ has been paid previously on ____________.
☐ is enclosed herewith.

03/31/2006 TBESHAH1 00000019 500922 10638989
01 FC:2453 750.00 DA

3. Terminal disclaimer with disclaimer fee

☑ Since this utility/plant application was filed on or after June 8, 1995, no terminal disclaimer is required.

☐ A terminal disclaimer (and disclaimer fee (37 CFR 1.20(d)) of $ ________ for a small entity or $ ________ for other than a small entity) disclaiming the required period of time is enclosed herewith (see PTO/SB/63).

4. STATEMENT: The entire delay in filing the required reply from the due date for the required reply until the filing of a grantable petition under 37 CFR 1.137(b) was unintentional. [NOTE: The United States Patent and Trademark Office may require additional information if there is a question as to whether either the abandonment or the delay in filing a petition under 37 CFR 1.137(b) was unintentional (MPEP 711.03(c), subsections (III)(C) and (D)).]

WARNING:

Petitioner/applicant is cautioned to avoid submitting personal information in documents filed in a patent application that may contribute to identity theft. Personal information such as social security numbers, bank account numbers, or credit card numbers (other than a check or credit card authorization form PTO-2038 submitted for payment purposes) is never required by the USPTO to support a petition or an application. If this type of personal information is included in documents submitted to the USPTO, petitioners/applicants should consider redacting such personal information from the documents before submitting them to the USPTO. Petitioner/applicant is advised that the record of a patent application is available to the public after publication of the application (unless a non-publication request in compliance with 37 CFR 1.213(a) is made in the application) or issuance of a patent. Furthermore, the record from an abandoned application may also be available to the public if the application is referenced in a published application or an issued patent (see 37 CFR 1.14). Checks and credit card authorization forms PTO-2038 submitted for payment purposes are not retained in the application file and therefore are not publicly available.

Tomas Lendvai	03/28/2006
Signature	Date
Tomas Lendvai, Ph.D.	57,488
Typed or printed name	Registration Number, if applicable
Second Sight Medical Products, Inc.	818-833-5072
Address	Telephone Number
12744 San Fernando Rd., Sylmar, CA 91432	
Address	

Enclosures: ☑ Fee Payment

☐ Reply

☐ Terminal Disclaimer Form

☐ Additional sheets containing statements establishing unintentional delay

☑ Other: Letter and Annexes 1-4

CERTIFICATE OF MAILING OR TRANSMISSION [37 CFR 1.8(a)]

I hereby certify that this correspondence is being:

☑ Deposited with the United States Postal Service on the date shown below with sufficient postage as ~~first class~~ mail in an envelope addressed to: Mail Stop Petition, Commissioner for Patents, P. O. Box 1450, Alexandria, VA 22313-1450.

☐ ~~Transmitted by facsimile on the date shown below to the United States Patent and Trademark Office as (571) 273-8300.~~

03/28/2006	
Date	Signature
	Deanna Fintz
	Typed or printed name of person signing certificate

Express Mail No. EV 829402841 US

PTO/SB/17 (01-06)
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Fees pursuant to the Consolidated Appropriations Act, 2005 (H.R. 4818).

FEE TRANSMITTAL
For FY 2006

☑ Applicant claims small entity status. See 37 CFR 1.27

TOTAL AMOUNT OF PAYMENT ($) 750.00

Complete if Known	
Application Number	10/638,989
Filing Date	August 11, 2003
First Named Inventor	Robert J. Greenberg, et al.
Examiner Name	
Art Unit	
Attorney Docket No.	S230-USA

METHOD OF PAYMENT (check all that apply)

☐ Check ☐ Credit Card ☐ Money Order ☐ None ☐ Other (please identify): ____

☑ Deposit Account Deposit Account Number: 50-0922 Deposit Account Name: ____

For the above-identified deposit account, the Director is hereby authorized to: (check all that apply)

☑ Charge fee(s) indicated below ☐ Charge fee(s) indicated below, **except for the filing fee**

☐ Charge any additional fee(s) or underpayments of fee(s) under 37 CFR 1.16 and 1.17 ☐ Credit any overpayments

WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.

FEE CALCULATION (All the fees below are due upon filing or may be subject to a surcharge.)

1. BASIC FILING, SEARCH, AND EXAMINATION FEES

	FILING FEES		SEARCH FEES		EXAMINATION FEES		
Application Type	**Fee ($)**	**Small Entity Fee ($)**	**Fee ($)**	**Small Entity Fee ($)**	**Fee ($)**	**Small Entity Fee ($)**	**Fees Paid ($)**
Utility	300	150	500	250	200	100	
Design	200	100	100	50	130	65	
Plant	200	100	300	150	160	80	
Reissue	300	150	500	250	600	300	
Provisional	200	100	0	0	0	0	

2. EXCESS CLAIM FEES

Fee Description	**Fee ($)**	**Small Entity Fee ($)**
Each claim over 20 (including Reissues)	50	25
Each independent claim over 3 (including Reissues)	200	100
Multiple dependent claims	360	180

Total Claims ____ - 20 or HP = **Extra Claims** ____ x **Fee ($)** ____ = **Fee Paid ($)** ____

HP = highest number of total claims paid for, if greater than 20.

Indep. Claims ____ - 3 or HP = **Extra Claims** ____ x **Fee ($)** ____ = **Fee Paid ($)** ____

HP = highest number of independent claims paid for, if greater than 3.

Multiple Dependent Claims
Fee ($) ____ **Fee Paid ($)** ____

3. APPLICATION SIZE FEE

If the specification and drawings exceed 100 sheets of paper (excluding electronically filed sequence or computer listings under 37 CFR 1.52(e)), the application size fee due is $250 ($125 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).

Total Sheets ____ - 100 = **Extra Sheets** ____ / 50 = **Number of each additional 50 or fraction thereof** ____ (round up to a whole number) x **Fee ($)** ____ = **Fee Paid ($)** ____

4. OTHER FEE(S) **Fees Paid ($)**

Non-English Specification, $130 fee (no small entity discount) ____

Other (e.g., late filing surcharge): Small entity-fee (37CFR 1.17(m)) Petition under 37 CFR 1.137(b) 750.00

SUBMITTED BY

Signature	Tomas Lendvai	Registration No. (Attorney/Agent) 57,488	Telephone 818-833-5072
Name (Print/Type)	Tomas Lendvai, Ph.D.		Date March 28, 2006

-ket No.:S230-USA Date Mailed: A st 11, 2003 By: Lisa Cody

-ial No. :____________ Title: Insulated Implantable Electrical Conductor

Application Type: Utility # of pages: 13 # of drawings: 2

- ✓ Declaration
- ✓ Power of Attorney
- ✓ IDS # of references: 11
- ✓ Drawings # of page(s): 1
- ✓ Certificate of mailing - Exp. Mail No.: EV29195076US

8/11/2003

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Label 11-F June 2002

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SECOND SIGHT, LLC
12744 SAN FERNANDO RD BLDG 3
SYLMAR CA 91342-3728

S230-USA

TO: (PLEASE PRINT) PHONE ( )

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ACCOUNT NO: 913023 PERIOD: 08/09/03 - 09/05/03

DATE	CHARGE BACK	LABEL NUMBER	ORIG ZIP	DEST ZIP	ADJ # REF *	POSTAGE	FEES PICKUP	FEES DELIVERY	DEPOSITS	WITH-DRAWALS	CDA LEG
BEGINNING BALANCE:						45.60-					
08/05/03		EV292195045US	91406	22313		17.85					
08/05/03		EV292195059US	91406	22313		13.65					
08/11/03		EV292195076US	91406	22313		17.85					
08/11/03		EV292195080US	91406	22313		13.65					
08/12/03		EV292195062US	91406	22313		13.65					
SUB-TOTAL:						76.65					
(A) TOTAL CHARGES :						76.65	0.00	0.00			
(B) TOTAL ADJUSTMENTS (#):						0.00	0.00	0.00			
(C) TOTAL REFUNDS (*):						0.00	0.00	0.00			
TOTAL (A + B - C):						76.65	0.00	0.00			
08/09/03		DEPOSIT							34.05		
09/04/03		DEPOSIT							247.55		
ENDING BALANCE:						159.35					

SECOND SIGHT MEDICAL PRODUCTS, INC. 1306

Postmaster 10/6/2003

Date	Type	Reference	Original Amt.	Balance Due	Discount	Payment
09/06/2003	Bill		63.15	63.15		63.15
					Check Amount	63.15

City National Bank - Chec 63.15

51N311 (6/03) 104355

ACCOUNT NO.	ACCOUNT ZIP	STATEMENT DATE	BEGINNING PERIOD	ENDING PERIOD
913023	91409	09/06/03	08/09/03	09/05/03

	BEGINNING BALANCE	DEPOSITS	REFUNDS	POSTAGE	ADJUSTMENTS	WITHDRAWALS	TRANSFERRED TO PM	ENDING BALANCE
	45.60-	281.60	0.00	76.65	0.00	0.00	0.00	159.35
NO. OF TRANSACTIONS		2	0	5	0	0		

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Deposit Account Statement

Requested Statement Month: August 2003
Deposit Account Number: 500922
Name: SECOND SIGHT MEDICAL PRODUCTS, INC.
Attention: SCOTT B. DUNBAR
Address: 12744 SAN FERNANDO RD.
City: SYLMAR
State: CA
Zip: 91342
Country: UNITED STATES OF AMERICA

DATE	SEQ	POSTING REF TXT	ATTORNEY DOCKET NBR	FEE CODE	AMT	BAL
08/05	286	PCT/US03/23541	S245-PCT	1601	$240.00	$11,004.00
08/05	287	PCT/US03/23541	S245-PCT	1603	$450.00	$10,554.00
08/05	288	PCT/US03/23541	S245-PCT	1702	$476.00	$10,078.00
08/05	289	PCT/US03/23541	S245-PCT	1707	$520.00	$9,558.00
08/05	290	PCT/US03/23541	S245-PCT	8007	$40.00	$9,518.00
08/05	291	PCT/US03/23541	S245-PCT	8021	$40.00	$9,478.00
08/06	2	10046458	S000-USA	1806	$180.00	$9,298.00
08/08	30	10046458	S000-USA	2501	$650.00	$8,648.00
08/08	31	10046458	S000-USA	1504	$300.00	$8,348.00
08/08	49	10635633	S111-DIV1	2001	$375.00	$7,973.00
08/14	63	10638989	S230-USA	2001	$375.00	$7,598.00
08/14	64	10638989	S230-USA	2202	$45.00	$7,553.00
08/19	527	PCT/US03/25074	S230-PCT	1601	$240.00	$7,313.00
08/19	528	PCT/US03/25074	S230-PCT	1602	$700.00	$6,613.00
08/19	529	PCT/US03/25074	S230-PCT	1707	$520.00	$6,093.00
08/19	530	PCT/US03/25074	S230-PCT	8007	$40.00	$6,053.00

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UTILITY PATENT PLICATION TRANSMITTAL (New Nonprovisional Applications Under 37 CFR § 1.53(b))	Attorney Docket No. S230-USA

TO THE ASSISTANT COMMISSIONER FOR PATENTS:

Transmitted herewith is the patent application of ( ) application identifier or (X) first named inventor, Robert Greenberg, entitled Insulated Implantable Electrical Conductor, for a(n):

(X) Original Patent Application.

( ) Continuing Application (prior application not abandoned):
( ) Continuation ( ) Divisional ( ) Continuation-in-part (CIP)
of prior application No: ______________ Filed on: ______________.
( ) A statement claiming priority under 35 USC § 120 has been added to the specification.

Enclosed are:
(X) Specification; 14 Total Pages. (X) Drawing(s); 1 Total Sheets.
(X) Oath or Declaration:
(X) A Newly Executed Combined Declaration and Power of Attorney:
( ) Signed. ( ) Unsigned. (X) Partially Signed.
( ) A Copy from a Prior Application for Continuation/Divisional (37 CFR § 1.63(d)).
( ) Incorporation by Reference. The entire disclosure of the prior application, from which a copy of the oath or declaration is supplied, is considered as being part of the disclosure of the accompanying application and is hereby incorporated herein by reference.
( ) Signed Statement Deleting Inventor(s) Named in the Prior Application. (37 CFR § 163(d)(2)).
( ) Power of Attorney. (X) Return Receipt Postcard.
( ) Associate Power of Attorney. ( ) A Check in the amount of $__________ for the Filing Fee.
( ) Preliminary Amendment. (X) Information Disclosure Statement and Form PTO-1449.
( ) A Duplicate Copy of this Form for Processing Fee Against Deposit Account.
( ) A Certified Copy of Priority Documents (if foreign priority is claimed).
(X) Applicant claims small entity status.
( ) Other: ______________________________________.

CLAIMS AS FILED				
FOR	NO. FILED	NO. EXTRA	RATE	FEE
Total Claims	25	5	$9.00	$ 45.00
Independent Claims	2	0	$42.00	$ 0.00
Multiple Dependent Claims (if applicable)				$0.00
Assignment Recording Fee				$0.00
Basic Filing Fee				$375.00
			Total Filing Fee	$ 420.00

Charge $420.00 to Deposit Account 50-0922 pursuant to 37 CFR § 1.25. At any time during the pendency of this application, please charge any fees required or credit any overpayment to this Deposit Account.

Respectfully submitted,

By: ______________________
Gary Schnittgrund, Attorney of Record, Reg. No.42,130

Date: August 11, 2003

Correspondence Address:

Second Sight Medical Products, Inc.
12744 San Fernando Road, Building 3
Sylmar, CA 91342
Phone: (818) 833-5071
Fax: (818) 833-5080

I hereby certify that this is being deposited with the U.S. Postal Service "Express Mail Post Office to Addressee" service under 37 CFR § 1.10 on the date indicated below and is addressed to:

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By: ______________________

Typed Name: Lisa Cody

Express Mail Label No.: EV29195076US

Date of Deposit: August 11, 2003

UTILITY PATENT APPLICATION TRANSMITTAL (New Nonprovisional Applications Under 37 CFR § 1.53(b))	Attorney Docket No. S230-USA

TO THE ASSISTANT COMMISSIONER FOR PATENTS:

Transmitted herewith is the patent application of ( ) application identifier or (X) first named inventor, Robert Greenberg, entitled Insulated Implantable Electrical Conductor, for a(n):

(X) Original Patent Application.

( ) Continuing Application (prior application not abandoned):
( ) Continuation ( ) Divisional ( ) Continuation-in-part (CIP) .
of prior application No: ______________ Filed on: ______________.
( ) A statement claiming priority under 35 USC § 120 has been added to the specification.

Enclosed are:
(X) Specification; 14 Total Pages. (X) Drawing(s); 1 Total Sheets.
(X) Oath or Declaration:
(X) A Newly Executed Combined Declaration and Power of Attorney:
( ) Signed. ( ) Unsigned. (X) Partially Signed.
( ) A Copy from a Prior Application for Continuation/Divisional (37 CFR § 1.63(d)).
( ) Incorporation by Reference. The entire disclosure of the prior application, from which a copy of the oath or declaration is supplied, is considered as being part of the disclosure of the accompanying application and is hereby incorporated herein by reference.
( ) Signed Statement Deleting Inventor(s) Named in the Prior Application. (37 CFR § 163(d)(2)).
( ) Power of Attorney. (X) Return Receipt Postcard.
( ) Associate Power of Attorney. ( ) A Check in the amount of $__________for the Filing Fee.
( ) Preliminary Amendment. (X) Information Disclosure Statement and Form PTO-1449.
( ) A Duplicate Copy of this Form for Processing Fee Against Deposit Account.
( ) A Certified Copy of Priority Documents (if foreign priority is claimed).
(X) Applicant claims small entity status.
( ) Other: ____.

CLAIMS AS FILED				
FOR	NO. FILED	NO. EXTRA	RATE	FEE
Total Claims	25	5	$9.00	$ 45.00
Independent Claims	2	0	$42.00	$ 0.00
Multiple Dependent Claims (if applicable)				$0.00
Assignment Recording Fee				$0.00
Basic Filing Fee				$375.00
			Total Filing Fee	$ 420.00

Charge $420.00 to Deposit Account 50-0922 pursuant to 37 CFR § 1.25. At any time during the pendency of this application, please charge any fees required or credit any overpayment to this Deposit Account.

Respectfully submitted,

By: ______________________________
Gary Schnittgrund, Attorney of Record, Reg. No.42,130

Date: August 11, 2003

Correspondence Address:

Second Sight Medical Products, Inc.
12744 San Fernando Road, Building 3
Sylmar. CA 91342
Phone: (818) 833-5071
Fax: (818) 833-5080

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By: ______________________________

Typed Name: Lisa Cody

Express Mail Label No.: EV29195076US

Date of Deposit: August 11, 2003

PATENT APPLICATION

DECLARATION AND POWER OF ATTORI... FOR PATENT APPLICATION

...TORNEY DOCKET NO. S230-USA

\s a below named inventor, I hereby declare that:
My residence/post office address and citizenship are as stated below next to my name;
believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names re listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:
nsulated Implantable Electrical Conductor
he specification of which is attached hereto unless the following box is checked:
( ) was filed on ______________ as US Application Serial No. or PCT International Application Number ______________ and was amended on ______________ (if applicable).
hereby state that I have reviewed and understood the contents of the above-identified specification. including the claims, as amended by ny amendment(s) referred to above. I acknowledge the duty to disclose all information which is material to patentability as defined in 37 FR 1.56.

oreign Application(s) and/or Claim of Foreign Priority
hereby claim foreign priority benefits under Title 35, United States Code Section 119 of any foreign application(s) for patent or inventor(s) certificate listed below and ave also identified below any foreign application for patent or inventor(s) certificate having a filing date before that of the application on which priority is claimed:

COUNTRY	APPLICATION NUMBER	DATE FILED	PRIORITY CLAIMED UNDER 35 U.S.C. 119
			YES:____ NO:____
			YES:____ NO:____

'rovisional Application
hereby claim the benefit under Title 35, United States Code Section 119(e) of any United States provisional application(s) listed below:

APPLICATION SERIAL NUMBER	FILING DATE
60/402591	8/9/2002

.S. Priority Claim
hereby claim the benefit under Title 35, United States Code, Section 120 of any United States application(s) listed below and, insofar as the subject matter of each of the laims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code Section 112, I cknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, Section 1.56(a) which occurred between the filing date of the rior application and the national or PCT international filing date of this application:

APPLICATION SERIAL NUMBER	FILING DATE	STATUS(patented/pending/abandoned)

'OWER OF ATTORNEY:
\s a named inventor, I hereby appoint the following attorney(s) and/or agent(s) listed below to prosecute this application and transact all business in the Patent and Trademark Office connected therewith.

Gary Schnittgrund, Reg. No. 42,130 **Scott B. Dunbar, Reg. No. 37,124**

Send Correspondence to:

Gary Schnittgrund
Second Sight Medical Products, Inc.
12744 San Fernando Road, Building 3
Sylmar, CA 91342

Direct Telephone Calls To:

Gary Schnittgrund
(818) 833-5071

hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further hat these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both. under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full Name of Inventor: Robert Greenberg **Citizenship:** United States

Residence: 2431 Wild Oak Drive, Los Angeles, California 90068 USA

Post Office Address: Same

Inventor's Signature **Date**

Full Name of Inventor: Neil Talbot Citizenship: Australia

Residence: 2254 Mira Vista, #6, Montrose, California 91020

Post Office Address: Same

Inventor's Signature Date

Full Name of Inventor: Jerry Ok Citizenship: United States

Residence: 18123 Erik Court, #356, Valencia, California 91387

Post Office Address: Same

Inventor's Signature Date

Full Name of Inventor: Jordan Nevsmith Citizenship: Canada

Residence: 18035 Grace Lane, #102, Valencia, California 91387

Post Office Address: Same

Inventor's Signature Date

Full Name of Inventor: Citizenship:

Residence:

Post Office Address:

Inventor's Signature Date

Full Name of Inventor: Citizenship:

Residence:

Post Office Address:

Inventor's Signature Date

Full Name of Inventor: Citizenship:

Residence:

Post Office Address:

Inventor's Signature Date

APPLICATION FOR UNITED STATES LETTERS PATENT

INSULATED IMPLANTABLE ELECTRICAL CIRCUIT

Attorney Docket No. S230-USA

Inventors:

Robert J. Greenberg, M.D., Ph.D.,

Neil Hamilton Talbot, Ph.D.,

Jordan Neysmith, and

Jerry Ok

Gary Schnittgrund, Esq., Ph.D.
Bar No. 42,130

Second Sight Medical Products, Inc.
12744 San Fernando Road, Building 3
Sylmar, California 91342
818-833-5000

INSULATED IMPLANTABLE ELECTRICAL CIRCUIT

FEDERALLY SPONSORED RESEARCH

This invention was made with government support under grant No. R24EY12893-01, awarded by the National Institutes of Health. The government has certain rights in the invention.

PRIORITY CLAIM

This application claims the benefit of U.S. Application Number 60/402591 filed on August 9, 2002.

FIELD OF THE INVENTION

This invention relates to implantable medical devices, especially implantable cables and electrode arrays for stimulation, recording and interconnection.

BACKGROUND OF THE INVENTION

Arrays of electrodes for neural stimulation are commonly used for a variety of purposes. Some examples include U.S. Patent No. 3,699,970 to Brindley, which describes an array of cortical electrodes for visual stimulation. Each electrode is attached to a separate inductive coil for signal and power. U.S. Patent No. 4,573,481 to Bullara describes a helical electrode to be wrapped around an individual nerve fiber. U.S. Patent No. 4,837,049 to Byers describes spike electrodes for neural stimulation. Each spike electrode pierces neural tissue for better electrical contact. U.S. Patent No. 5,215,088 to Norman describes an array of spike electrodes for cortical stimulation. U.S. Patent No. 5,109,844 to de Juan describes a flat electrode array placed against the retina for visual stimulation. U.S. Patent 5,935,155 to Humayun describes a retinal prosthesis for use with a flat retinal array.

Packaging of a biomedical device intended for implantation in the eye, and more specifically for physical contact with the retina, presents a unique interconnection challenge. The consistency of the retina is comparable to that of wet tissue paper and the biological media inside the eye is a corrosive saline liquid environment.

Thus, the device to be placed against the retina, in addition to being comprised of biocompatible, electrochemically stable materials, must appropriately conform to the curvature of the eye, being sufficiently flexible and gentle in contact with the retina to avoid tissue damage, as discussed by Schneider, *et al.* [see A. Schneider, T. Stieglitz, W. Haberer, H. Beutel, and J.-Uwe Meyer, "Flexible Interconnects for Biomedical Microsystems Assembly," IMAPS Conference, January 31, 2001.] It is also desirable that this device, an electrode array, provides a maximum density of stimulation electrodes. A commonly accepted design for an electrode array is a very thin, flexible circuit cable. It is possible to fabricate a suitable electrode array using discrete wires, but with this approach, a high number of stimulation electrodes cannot be achieved without sacrificing cable flexibility (to a maximum of about 16 electrodes).

Known insulators for implanted electrical circuits include polyimide and silicone dielectrics. They have limited lives once implanted. The polyimide slowly degrades upon exposure to the living tissue and allows water to reach the electrical conductor, eventually leading to at least partial electric current leakage.

Known techniques for implanted electrical circuits do not result in a hermetic package that is suitable for chronic implantation in living tissue. Therefore, it is desired to have an insulated electrical conductor that ensures that the electronic package will function for long-term implant applications in living tissue.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 illustrates a cross-sectional view of an implantable electrical circuit.

FIG. 2 illustrates a cross-sectional view of an alternate implantable electrical circuit.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The preferred embodiment is an implantable insulated electrical circuit for electrical transmission within living organisms. These assemblies provide electrical conduction, isolation of the electrical conductors from the environment in the living tissue and from each other, and mechanical support for the electrical conductor. Electrical device assemblies that are commonly used for stimulation and or recording within the body benefit from the invention. Neural stimulators or sensors are of particular interest, including retinal electrode arrays. The implantable insulated electrical conductors may also be used to connect discrete components of an implanted medical device, permitting the transmission of electrical signals, power, as well as providing mechanical connection. Key attributes include good electrical insulation properties, low moisture absorption, appropriate mechanical characteristics and ease of fabrication.

Polyparaxylylene is a known polymer that has excellent implant characteristics. One example, Parylene, manufactured by Specialty Coating Systems (SCS), a division of Cookson Electronic Equipment Group, located in Indianapolis, Indiana, is a preferred material. Parylene is available in various forms, such as Parylene C, Parylene D, and Parylene N, each having different properties. The preferred form is Parylene C, although it is recognized that many forms of polyparaxylylene may exist or may be developed that are suitable for this application.

The use of Parylene was mentioned, but not pursued, by Sonn and Feist. [see M. Sonn and W. M. Feist, "A Prototype Flexible Microelectrode Array for Implant-Prosthesis Applications," Medical and Biological Engineering, 778-791, November 1974.] Stieglitz, et al. published fabrication details of similar items manufactured using polyimide. [see T. Stieglitz, H. Beutel, M. Schuettler, and J.-U. Meyer, "Micromachined, Polyimide-Based Devices for Flexible Neural Interfaces," Biomedical Microdevices, 2:4, 283-294, 2000.] Ganesh wrote a thesis on ribbon cables for neural recording and stimulation using polyimide [see B. Ganesh, "A Polyimide Ribbon Cable for Neural Recording and Stimulation Systems," Thesis, University of Utah, March 1998.] Parylene is widely used as

an electrical insulating and barrier material in commercial electronic devices. It is well known to use Parylene as a conformal coating on printed circuit boards. While discrete wires have been coated with Parylene for implantation, such as with cochlear implants, the application of Parylene as an electrical insulator for implantable electrical circuits, as embodied by this invention, is unknown to the inventors.

The moisture vapor transmission rates compare favorably with those of other conformal coating materials. The rate for Parylene C is superior to almost all polymeric materials. The Parylenes resist room temperature chemical attack and are insoluble in organic solvents up to 150°C. Parylene C can be dissolved in chloro-napthalene at 175°C, and Parylene N is soluble at the solvent's boiling point (265°C). The thermal properties are given in **Table 1** and the electrical properties are given in **Table 2**.

TABLE 1. Parylene Thermal Properties (2)

Properties	Method	Parylene N	Parylene C	Parylene D	Epoxides (1)	Silicones (1)	Urethanes (1)
Melting Point (°C)	1	420	290	380	cured	cured	~170
T5 Point (°C) (modulus = (10^5 psi)	1	160	125	125	110	~125	~30
T4 Point (°C) (modulus = (10^4 psi)	1	>300	240	240	120	~80	0
Linear Coefficient of Expansion at 25°C ($x10^5$, $(°C)^{-1}$)	-	6.9	3.5	3-8	4.5-6.5	25-30	10-20
Thermal Conductivity at 25°C (10^{-4} cal/(cm•s•°C))	2	3.0	2.0	-	4-5	3.5-7.5	5.0
Specific Heat at 20°C (cal/g °C)	-	0.20	0.17	-	0.25	-	0.42

Test Methods 1. Taken from Secant modulus-temperature curve
2. ASTM C 177

(1)Properties and methods as reported in *Modern Plastics Encyclopedia*, issue for 1968, Vol. 45/No. 1A, McGraw Hill, New York, 1967
(2) After Specialty Coating Systems, Indianapolis, IN.

TABLE 2. Parylene Electrical Properties (3)

Properties (1)	Parylene N	Parylene C	Parylene D	Epoxides (2)	Silicones (2)	Urethanes (2)
Dielectric Strength, dc volts/mil short time, 1 mil films[a]	7,000	5,600	5.500			
Corrected to 1/8 inch	630	500	490	400-500	550	450-500
Volume Resistivity ohm-cm, 23°C, 50% RH[b]	$1.4X10^{17}$	$8.8X10^{16}$	$1.2X10^{17}$	10^{12}-10^{17}	10^{15}	10^{11}-10^{15}
Surface Resistivity, ohms, 23°C, 50% RH[b]	10^{13}	10^{14}	10^{16}	10^{13}	10^{13}	10^{14}
Dielectric Constant[c]						
60 Hz	2.65	3.15	2.84	3.5-5.0	2.7-3.1	5.3-7.8
1 KHz	2.65	3.10	2.82	3.5-4.5	2.6-2.7	5.4-7.6
1 MHz	2.65	2.95	2.80	3.3-4.0	2.6-2.7	4.2-5.2
Dissipation Factor						
60 Hz	0.0002	0.020	0.004	0.002-0.01	0.001-0.007	0.015-0.05
1 KHz	0.0002	0.019	0.003	0.002-0.02	0.001-0.005	0.04-0.06
1 MHz	0.0006	0.013	0.002	0.03-0.05	0.001-0.002	0.05-0.07

[a] ASTM D 149
[b] ASTM D 257, 1 in^2 mercury electrodes
[c] ASTM D 150, 1 in^2

(1) Properties measured on Parylene films, 0.001 in thick.
(2) Properties and methods as reported in *Modern Plastics Encyclopedia,* issue for 1968, vol. 45, No. 1A, McGraw Hill, NY, 1967.
(3) After Specialty Coating Systems, Indianapolis, IN.

A cross-sectional view of a preferred embodiment of the invention is presented in **FIG. 1**. An electrical circuit 1 is shown generally being formed on a rigid substrate 2. The substrate 2 may be selected from glass or ceramic, such as alumina or silicon. Substrate 2 is preferably comprised of glass.

A first Parylene layer 4 is deposited on the substrate 2 from a vapor phase that is produced by known techniques, such as thermal decomposition. It is known that Parylene is the polymer "polyparaxylylene" and that any source of this material may be used to implement this invention. The inventors use the term Parylene, as is common in industry practice, to indicate the class of polyparaxylylene polymers.

An electrical conductor 6 is deposited by a known physical vapor deposition method, such as sputtering or evaporation. While the preferred embodiment is to an electrical conductor 6 that is comprised of one material, it is clear that the electrical conductor 6 may also be comprised of layers of several materials. Alternatively, the conductor 6 or combination thereof may be deposited by other known methods, such as direct write, plating, or electrophoresis. The electrical conductor 6 is patterned by known techniques, such as lift-off or etching. The electrical conductor 6 may be comprised of a single metal or in an alternate embodiment, from several metals that may be layered or alloyed, that are selected from a group of electrically conductive biocompatible materials having favorable electrochemical characteristics, such as titanium, platinum, gold, iridium, and their alloys. Multiple metals may be used in order to achieve desired characteristics. For example, adhesion and barrier layers are commonly used in electronics where individual metal layers are combined to yield a more functional circuit stack. These electrical conduction paths, traces, bond pads, and electrode sites are formed prior to depositing a second layer of Parylene 8 to the device. Typical thicknesses of each Parylene layer are in the range of 0.5 to 50 microns, and preferably are about 3 to 15 microns thick. An alternate embodiment uses metals that are not biocompatible, so long as they are completely encapsulated by the surrounding structural elements and thus do not contact living tissue.

In an alternate embodiment, non-biocompatible materials, such as chrome, silver, or copper may be used as the electrical conductor 6. The electrical conductor 6 is then coated with a biocompatible, hermetic coating in the exposed aperture 6 area. This coating is preferably titanium nitride, although in alternative embodiments it may be an electrically conductive biocompatible metal, such as titanium, platinum, gold, iridium, or their alloys. The Parylene layers cover and protect the rest of the electrical conductor 6.

Apertures 10 are patterned by known techniques, such as by dry etching or laser ablation, or by reactive ion etching. The apertures 10 permit electrical conduction to either tissue or a connected implanted device. The apertures 10 define an electrode area on the electrical conductor 6.

The rigid substrate 2 is removed by known techniques, such as mechanical separation or etching, where mechanical separation is the preferred technique.

As a further embodiment of the invention, adhesion between the first layer of Parylene 4 and the second layer of Parylene 8 is preferably improved by one or more of the following techniques:

(a) Silane application between Parylene layers.

(b) Chemical modification of the Parylene surface to create an energetic, a reactive, or an amorphous surface (Parylene is amorphous as deposited).

(c) Roughening of the Parylene surface.

(d) Thermal compression of the Parylene layers.

Techniques (b) and (c) can used to improve the metal to Parylene adhesion, if applied prior to metal deposition.

More than one electrical conductor 6 may be deposited adjacent to the Parylene. Additional metal layers may be deposited that are protected by additional Parylene layers, such that a multilayered higher density electrical circuit is achieved.

A further alternative embodiment, **FIG. 2**, of the invention preferably replaces the first layer of Parylene 4 with a polymer layer 111 , which is preferably polyimide, such that beginning with the rigid substrate 102, the layers

are, preferably, polymer layer 111 (polyimide) - electrical conductor 106 - layer of Parylene 104. The polyimide is preferably applied as a liquid.

In an alternative embodiment, not illustrated, one applies a first polymer coating, preferably polyimide, prior to depositing the first Parylene layer, such that beginning with the rigid substrate, the layers are, polymer layer (preferably polyimide) - first Parylene layer - electrical conductor - second layer of Parylene.

In yet another embodiment, not illustrated, a polymer coating, preferably of polyimide is applied between the Parylene layer and the electrical conductor.

In further embodiments, not illustrated, a polymer coating, preferably of polyimide is deposited on either side of the second layer of Parylene, either in the presence or absence of a polymer coating on the first layer of Parylene.

Obviously, many modifications and variations of the present invention are possible in light of the above teachings. It is therefore to be understood that, within the scope of the appended claims, the invention may be practiced otherwise than as specifically described.

CLAIMS

What is claimed is:

1. An insulated flexible electrical circuit suitable for implantation comprising:

a first polyparaxylylene layer;

a second polyparaxylylene that defines at least one aperture exposing an electrical conductor, and

said electrical conductor located between said first polyparaxylylene layer and said second polyparaxylylene layer.

2. The electrical circuit of claim 1, wherein said polyparaxylylene is comprised of Parylene.

3. The electrical circuit of claim 1, further comprising at least one polymer layer between said first polyparaxylylene layer and said second polyparaxylylene layer.

4. The electrical circuit of claim 3, wherein said polymer is comprised of polyimide.

5. The electrical circuit of claim 1, further comprising at least one polymer layer on said first polyparaxylylene layer or said second polyparaxylylene layer that is not located between said layers.

6. The electrical circuit of claim 5, wherein said polymer is comprised of polyimide.

7. The electrical circuit of claim 1, further comprising a layer of a polymer between said first polyparaxylylene layer and said electrical conductor.

8. The electrical circuit of claim 7, wherein said polymer is comprised of polyimide.

9. The electrical circuit of claim 1, wherein said electrical conductor is suitable for stimulating a nerve.

10. The electrical circuit of claim 1, wherein said electrical conductor is suitable for sensing a signal from a nerve.

11. The electrical circuit of claim 1, wherein said second polyparaxylylene that defines at least one aperture further defines an electrode site suitable for detecting or transmitting signals to living tissue.

12. The electrical circuit of claim 1, wherein said electrical conductor is comprised of a biocompatible material.

13. The electrical circuit of claim 12, wherein said biocompatible material is selected from at least one metal from the group of titanium, platinum, gold, or iridium.

14. The electrical circuit of claim 1, wherein said electrical conductor is at least partially coated with a biocompatible material.

15. The electrical circuit of claim 14, wherein said biocompatible material is comprised of titanium nitride.

16. A method of forming an insulated flexible electrical circuit suitable for implantation, comprising the steps of:

choosing a rigid substrate;

cleaning said rigid substrate;

depositing a first polyparaxylylene layer on said rigid substrate;

depositing an electrical conductor on said first polyparaxylylene layer;

patterning said electrical conductor to form a conductive path thereon;

depositing a second polyparaxylylene layer;

defining at least one select portion of said second polyparaxylylene layer; and

removing said at least one select portion of said second polyparaxylylene layer defining at least one aperture therein, thereby forming at least one electrode that is suitable for contacting living tissue.

17. The method of claim 16, wherein said step of choosing a rigid substrate is accomplished by choosing said substrate comprised of glass.

18. The method of claim 16, further comprising the step of enhancing said first polyparaxylylene layer for adhesion after said step of depositing a first polyparaxylylene layer.

19. The method of claim 16, further comprising the step of enhancing said electrical conductor for adhesion after said step of patterning said electrical conductor to form a conductive path.

20. The method of claim 16, further comprising the step of enhancing said first polyparaxylylene layer for adhesion before said step of depositing a second polyparaxylylene layer.

21. The method of claim 16, further comprising the step of applying silane to enhance adhesion.

22. The method of claim 16, further comprising the step of modifying by chemical means said first polyparaxylylene layer.

23. The method of claim 16, further comprising the step of roughening the polyparaxylylene surface.

24. The method of claim 16, further comprising the step of compressing thermally said first polyparaxylylene layer and said second polyparaxylylene layer to increase adhesion.

25. The method of claim 16, wherein said step of removing said at least one select portion of said second polyparaxylylene layer is accomplished by etching with reactive ions.

INSULATED IMPLANTABLE ELECTRICAL CIRCUIT

ABSTRACT OF THE DISCLOSURE

The invention is directed to an implantable insulated electrical circuit that utilizes polyparaxylylene, preferably as Parylene, a known polymer that has excellent living tissue implant characteristics, to provide for chronic implantation of conductive electrical devices, such as stimulators and sensors. The device is thin, flexible, electrically insulated, and stable after long exposure to living tissue. Layers of Parylene may be combined with layers of a polymer, such as polyimide, to yield greater design flexibility in the circuit. Multiple electrical conduction layers may be stacked in the circuit to increase packing density.

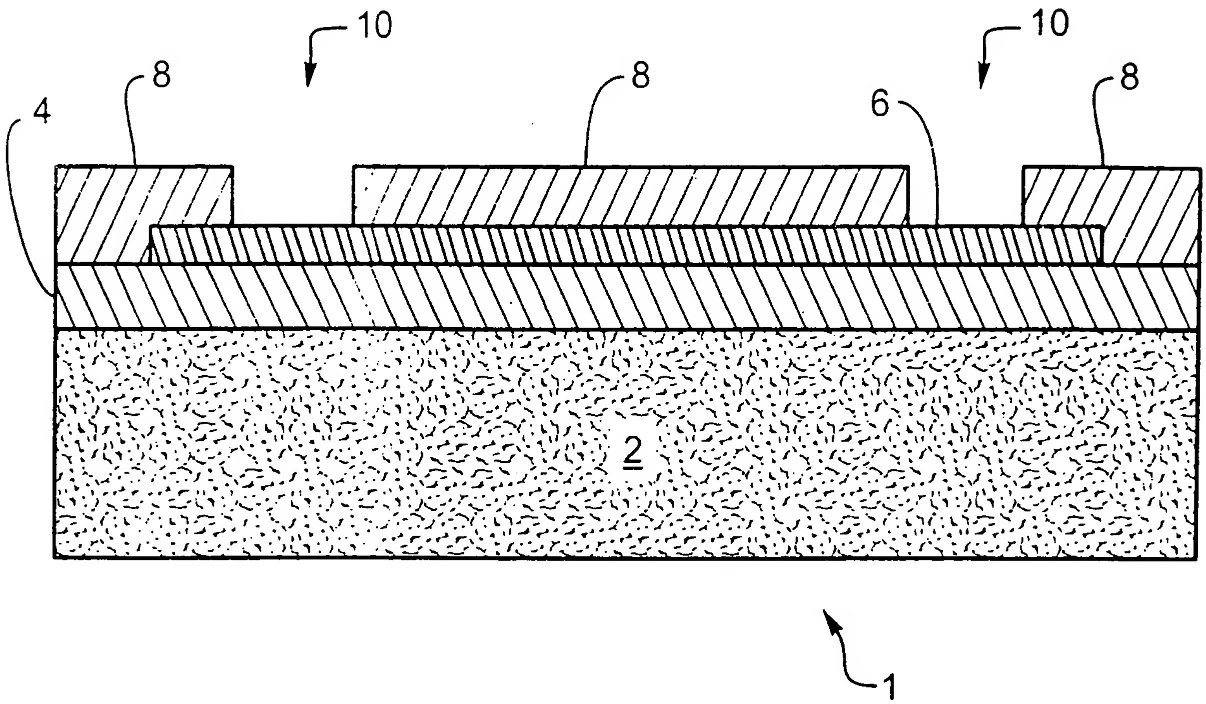

Fig. 1

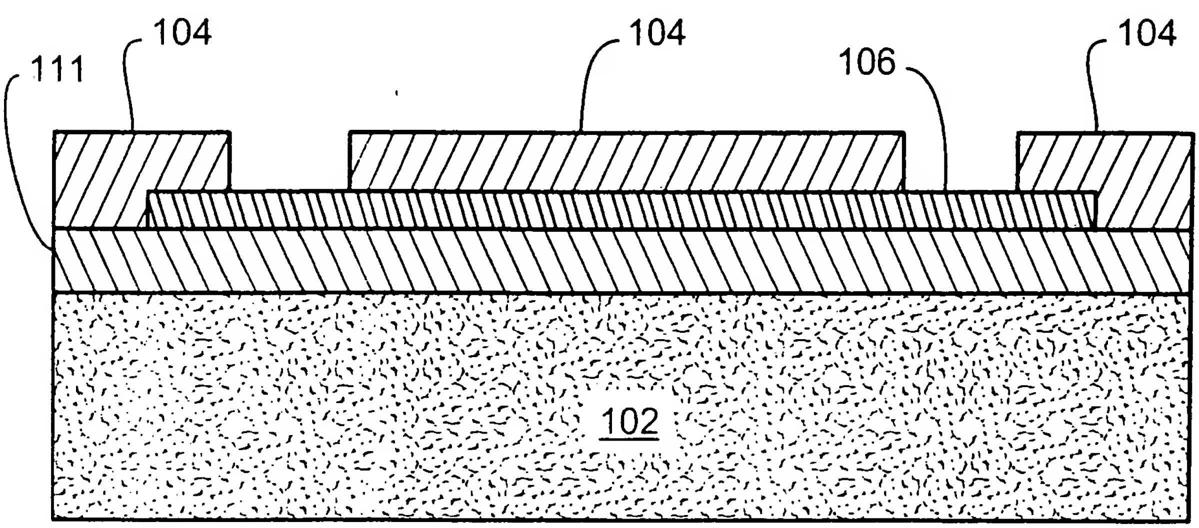

Fig. 2

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant(s): Greenberg et al.	
Serial No.:	
Filed:	Group Art Unit:
Title: Insulated Implantable Electrical Conductor	Examiner:
Attorney Docket No.: S230-USA	

Commissioner for Patents
Alexandria, VA 22313-1450

INFORMATION DISCLOSURE STATEMENT

Dear Sir:

This Information Disclosure Statement is submitted:

_✓_ under 37 CFR 1.97(b), or
(Within three months of filing national application; or date of entry of international application; or before mailing date of first office action on the merits; whichever occurs last)

__ under 37 CFR 1.97(c) together with either a:
__ Statement under 37 CFR 1.97(e), or
__ a $180.00 fee under 37 CFR 1.17(p), or
(After the CFR 1.97(b) time period, but before final action or notice of allowance, whichever occurs first)

__ under 37 CFR 1.97(d) together with a:
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_X_ Applicant(s) submit herewith Form PTO 1449-Information Disclosure Citation together with copies, of patents, publications or other information of which applicant(s) are aware, which applicant(s) believe(s) may be material to the examination of this application and for which there may be a duty to disclose in accordance with 37 CFR 1.56.

The relevance of the attached references is that this is the closest art of which Applicant is aware.

Applicant submits that the above references taken alone or in combination neither anticipate nor render obvious the present invention. Consideration of the foregoing in relation to this application is respectfully requested.

It is requested that the information disclosed herein be made of record in this application.

Respectfully submitted,

I hereby certify that this correspondence is being deposited with the United States Postal Service as Express Mail in an envelope addressed to: Commissioner for Patents, Alexandria, VA 22313-1450.

Date of Deposit: August 11, 2003

Typed Name: Lisa Cody

Signature:

Gary Schnittgrund
Attorney/Agent for Applicant(s)
Reg. No. 42,130

Date: August 11, 2003

Telephone No.: (818) 833-5071

PTO/SB/08A (10-01)
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(use as many sheets as necessary)

Sheet 1 of 2

Complete if Known	
Application Number	
Filing Date	
First Named Inventor	Greenberg et al.
Art Unit	
Examiner Name	
Attorney Docket Number	S230-USA

U.S. PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Document Number: Number - Kind Code[2] (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
		US-5,109,844	05/05/1992	De Juan, Jr., et al.	
		US-5,935,155	08/10/1999	Humayan, et al.	
		US-3,699,970	10/24/1972	Brindley, et al.	
		US-4,573,481	03/04/1986	Bullara, et al.	
		US-4,837,049	06/06/1989	Byers, et al.	
		US-5,215,088	06/01/1993	Normann, et al.	
		US-6,374,143	04/16/2002	Berrang, et al.	
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	Filing Date	
	First Named Inventor	Greenberg et al.
	Group Art Unit	
	Examiner Name	
Sheet 2 of 2	Attorney Docket Number	S230-USA

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Examiner Initials*	Cite No.[1]	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published.	T[2]
		M. SONN and W.M. FEIST; *"A Prototype Flexible Microelectrode Array for Implant-Prosthesis Applications,"* Medical and Biological Engineering, 778-791, November 1974	
		T. STIEGLITZ, H. BEUTEL, M. SCHUETTLER, and J.-U. MEYER, *"Micromachined, Polyimide-Based Devices for Flexible Neural Interfaces,"* Biomedical Microdevices, 2:4, 283-294, 2000.	
		B. GANESH, *"A Polyimide Ribbon Cable for Neural Recording and Stimulation Systems,"* Thesis, University of Utah, March 1998.	
		A. SCHNEIDER, T. STIEGLITZ, W. HABERER, H. BEUTEL, and J.-UWE MEYER, *"Flexible Interconnects for Biomedical Microsystems Assembly"*, IMAPS Conference, January 31, 2001	

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